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Memo

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Historical Background of the High Temperature Pile

Sept., 1944 Study of a ceramics pile started at Chicago in September, 1944, capable of operating at high temperatures - above the normal range of metals. Conferences were held with Compton, Wigner, Young, Zinn and others.

April, 1945 A budget was allowed for experimental study of high temperature pile.

July, 1945 A new section at the Metallurgical Laboratory started experimental work on BeO and related problems under Dr. Willard, and active research still continues at Chicago with a present staff of about 25 under Dr. O. C. Simpson. The contractor, University of Chicago, gave enthusiastic backing. Discussions were held with Allis-Chalmers Company. Dr. Sachs and assistants were engaged to work on nuclear calculations.

Jan., 1946 The Monsanto Company reported on the feasibility of the high temperature power pile. Arguments were continued between Col. Nichols and F. Daniels as to whether the pile should be developed at Chicago or at Oak Ridge.

Mar., 1946 General Nichols' Advisory Committee decided that the pile shall go to Oak Ridge and that an industrial company must accept responsibility for the pile. Dr. Thomas accepted this responsibility for the Monsanto Chemical Company, and placed Dr. C. R. McCullough in charge. It was understood that a new unit would be organized to design this pile, independent of the then existing staff of the Clinton Laboratories.

April, 1946 General Nichols called a conference of representatives from industry and outlined the proposed program. The army gave a press release describing the organization and plans.

May, 1946 Dr. McCullough employed a group of extremely able engineers and scientists, loaned by their companies, to design this pile. It was becoming increasingly clear that the staff of the Clinton Laboratories does not welcome the new high temperature pile.

June, 1946 The Power Pile Division of the Clinton Laboratories started work. Soodak started a course in pile physics to help the Power Pile Division. Dr. Wigner was appointed Director of Research of Clinton Laboratories.

<u>July, 1946</u> Daniels resigned his directorship of the Metallurgical Laboratory in Chicago in order to devote his full efforts as consultant at Oak Ridge to the development of this pile. McCullough placed himself and his Power Pile Division under the jurisdiction of Dr. Wigner.

<u>Sept., 1946</u> Stevens and Brittan Took an intensive course under Sachs to learn pile calculations. Daniels started spending alternate weeks at the University of Wisconsin.

<u>Oct., 1946</u> A comprehensive report is being prepared by the Power Pile Division.

Dr. Wigner objects to the proposed pile on the basis that the fuel tubes will crack at the higher power levels, that the cooling circuit will become radioactive, and that the proposals for the loading and unloading mechanism are not satisfactory. He believes that the controls can be worked out satisfactorily and that there is no special serious hazard connected with this pile, but he believes that metal piles will be more important than piles of BeO or graphite.

Dr. Wigner suggests that the Power Pile Division, under Dr. C. R. McCullough, study a pile using metallic beryllium and uranium.

<u>Arguments for Continuing the Present Program on BeO or BeO and Graphite</u>

It is important for the peace of the world to make a demonstration of an atomic power pile at the earliest possible moment.

It is necessary to operate an experimental pile at high temperatures in order to study the problems of control and other problems involved in the development of atomic power.

The experimental pile is needed immediately for testing the effects of intense radiation on materials at high temperatures.

A comprehensive program on the testing of beryllium oxide and uranium oxide has been completed.

One of the greatest assets in developing a research program is the enthusiasm and morale of the staff. These assets may be seriously affected by a radical change in the program.

The cost of reprocessing and fabricating is less for the oxides than for the metals.

[redacted]

The operating temperature can be higher for an oxide pile than for a metal pile on account of the higher melting point and volatility temperature.

High operating temperatures are needed for the operation of gas turbines, and it appears likely that gas turbines will become increasingly important.

Efficient heat transfer is favored by the high operating temperature obtainable within an oxide pile.

Although metallic fuel will permit the fabrication of thin units and a much larger surface area than an oxide fuel, the power required to force the coolant through the pile will be greater on account of the small cross-section of the individual channels.

The advantage of the smaller size made possible by the use of beryllium metal may be offset by the large amount of power required to force the coolant through the smaller pile.

No data are now available on the effect of fission recoils in beryllium - uranium alloys, and several months will be required to obtain the necessary experimental data at Hanford.

According to recent conferences with the army, the procurement and time of delivery is much more favorable for pure BeO than for pure beryllium metal. Research is still needed in the fabrication and properties of beryllium. A serious delay was anticipated in obtaining sufficient beryllium metal for the heterogeneous pile; the situation will be made worse if, in addition, there is an increased demand for beryllium metal for a power pile.

It is probably more important at the present time to build and operate an experimental pile at high temperatures soon than it is to strive for perfection. The success of the pile should be judged on the basis of what is learned from it rather than on the months of continuous operation.

The BeO pile as presently designed is well suited for testing the behavior of fuel tubes of beryllium-uranium alloy (and impregnated graphite as well) without taking the time and the possible new difficulties involved in designing a whole new pile.

The uranium and beryllium alloy pile has long been discussed at the Metallurgical Laboratory, and one is now being studied in Chicago. Preliminary drawings have been made and a supply of beryllium metal has been acquired for making nuclear measurements.

Clinton Laboratories should not run the danger of changing plans so often that it accomplishes little.

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Arguments for A Metallic-Beryllium-Uranium Pile

The metals have more desirable mechanical properties than the oxides or graphite.

The pile will be smaller (provided that the heat can be removed without building up excessive resistance to flow of the coolant with resulting prohibitive power requirements).

The problem of the cracking of fuel rods will probably be eliminated and the radioactivity in the external circuit may be eliminated.

A long time may be required for the delivery of a large order of BeO of sufficient purity.

For portable atomic energy units (as on ships) the smaller metallic pile has great advantages.

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